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AN INTRODUCTION TO THE ECONOMICS OF FISHERIES MANAGEMENT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

AN INTRODUCTION TO THE ECONOMICS OF FISHERIES MANAGEMENT

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS PAPER

This document has been prepared as part of FAO's Regular Programme activities, aimed at assisting fishery administrators and other persons responsible for the management of fisheries. It is one in a series of technical papers relating to the PRACTICES OF FISHERIES MANAGEMENT. The list of these papers is given at the end of this document.

This document has been prepared as an aid in training courses in fishery management and development. It focusses primarily on the economic aspects of fishery management and particularly within the context of free market economies and in conditions where unemployment is not a severe problem. Emphasis is given to the regulation of fishing effort as a means for overcoming the economic efficiency that is associated with common property fisheries. The approach taken in the paper is valid and important for many situations, but it is not universally applicable. It must be recognized that the goal of optimizing social benefits from fishery development and management can be achieved in a variety of ways in accordance with each nation's individual value system.Issuance of the document does not imply the expression by FAO of any opinion whatsoever concerning the legal or constitutional status of any country, territory or sea area, concerning the delimitation of boundaries or concerning any country's policy making and administrative procedure.

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ABSTRACT

Fishery management relates to a total system made up of resources, industry and trade. There are important linkages between these components. In contrast with other resource industries, common property in fishery resources implies that there is no market mechanism through which access to these resources could be allocated among users. In many cases, governments have been forced to intervene, rightly or wrongly, to fill this vacuum. Economically, rational fishery management necessitates the transformation of common property through some kind of limited entry system designed to optimize net benefits from the fishery. Management planning involves the definition of goals and policy objectives and the development of strategies to assure attainment of policy objectives.

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Needless to say, none of those referred to is to be blamed for the shortcomings and blemishes that remain. In that respect, the writer solely is culpable.

W.C. MacKenzie
Ottawa
(March 1982)

EXECUTIVE SUMMARY

1. THE COMMERCIAL FISHERIES AS A SYSTEM

1.1 Preamble

A major theme of this paper is that fishery management relates to the total system, consisting of the resource base and the (harvesting and processing) industry and the trade by means of which the natural resources are utilized in the service of product markets. The central objective of management is optimization of the aggregate social benefit derived from these activities as a whole.

1.2 Component Structure

1.2.1 The Resource Base

The natural-resource base consists of the resource endowment, i.e. stocks of fish species, and the supporting natural environment or habitat. Protection of that habitat as well as conservation of the fish stocks therein is a primary responsibility of fishery management.

Fishery resources are finite, stocks are exhaustible and interrelationships among them are highly complex. Knowledge of stock magnitude, behaviour and response to fishing pressure therefore is imperative for intelligent management.

A peculiarity of fishery resources is that traditionally (with minor exceptions) they, as well as their aquatic habitat, have been common property. The extension of fishery-management jurisdictions (200-mile EEZs) by coastal states has transformed extensive tracts of these resources into national (from formerly international) common property. Because of differences in cost structure and social values, negotiations between countries for the allocation of shared resources present some of the most difficult problems for fishery management.

1.2.2 The Primary Fishing Industry

This division of the commercial fisheries consists of the enterprises (of all types and sizes) engaged in the harvesting of fishery resources. Organization varies greatly from place to place, depending on historical evolvement and on current economic and socio-political factors.

As a consequence of open and free access to the use of common-property resources, traditional in the fisheries of most parts of the world, which compels fishing enterprises to disregard collective interests in a progressively intensified competition for shares of a (naturally or administratively) limited catch, mature industries are prone to crises and impoverishment. Because of the resulting pressure to circumvent and/or emasculate fishery regulations, a secondary effect often is depletion of the natural resources, which compounds the problem. The small-scale or artisanal fisheries, which in many places are an occupation of last resort, tend especially (as a result of gross overcrowding) to be devastated by such crises.

The divergence between individual and collective interests is the cause of the inter-group conflicts that are a characteristic of the fisheries almost everywhere, e.g. conflicts between small-scale (inshore) and large-scale groups dependent on the same market and between domestic and foreign fishermen.

1.2.3 The Fish Processing Industry and the Fish Trade

The processing of fish in advanced forms (filleting, freezing, curing and canning) becomes an important industrial segment when fish must be stored and/or transported to distant markets. Storage

is required when supply and demand are out of phase seasonally, i.e. when either production or consumption are concentrated in particular periods of each year. Peakedness in the catch is often inevitable but sometimes is due to poor organization or to the use of an inadequate, i.e. small-scale and relatively immobile, harvesting technology.

Economies of scale in fish processing are realized principally in business organization, i.e. in the bulk-purchase of supplies and consolidation of marketing, for example, rather than in the processing operation itself. Like artisanal fishing and in contrast with industrialized fishing, fish processing tends generally to be labour intensive.

The fish-processing industry and by extension the fish trade (marketing and distribution) sometimes reflect the fragmentation and dispersion of the fish harvesting industry. This can be a cause of excessive costs and, in the case of export trading, a source of weakness in competition with better organized rivals.

1.3 Linkages and Interdependence

1.3.1 Factor Supply

Since the fisheries are an open system, there are important linkages with sources for the supply of labour and capital. Capital requirements include funds for investment in capital assets (infrastructure, plant, vessels, gear, etc.) and for operation (payroll and inventory financing, etc.). Primary fishing enterprises especially often are unattractive to private sources of funding (banks and the like). Because of this, governments are induced to provide credit services for the fisheries. Unfortunately, intervention in this way by government tends to reinforce the inherent pressures toward over-expansion in the commercial fisheries.

On the other hand, the provision of public goods, e.g. scientific-research and extension services, harbour works and so on, which are accepted as a legitimate responsibility of government in most societies, is an essential underpinning of fishery development.

The commercial fisheries are linked with a wide variety of equipment-supply sources, the major such source being the shipbuilding industry and ancillary industries and services associated with it. Through these linkages, the development of a viable fisheries sector (in proportion to its size) may bring about a significant development in other sectors of the national economy.

1.3.2 Product Markets

The initiation, adaptation and expansion of fishery production is determined by opportunities for the sale of products. The demand for food products of the fisheries tends to be inelastic but is subject, to some extent, to manipulation.

A product market transmits, by means of prices, intensive demands for some species and rejection of others. Effective management of fishery-resource use in an ecological context, however, presumably would require balanced exploitation of the species stocks involved. Market signals, that is, fail as a guide for management decisions in this respect.

2. MANAGEMENT OF THE FISHERIES

2.1 Introduction

2.1.1 The Involvement of the State

In contrast with other resource industries, common property in fishery resources implies that there is no market mechanism through which access to these resources could be allocated among users. More or less inadvertently, government has been drawn into the vacuum.

Governments have tended to adopt employment maximization in the fisheries as the primary objective of management and to concentrate effort on the resolution of conflict among vested interests. Since the former action contributes to the latter problem, this approach to fishery management is self-defeating. It leads, moreover, to intolerable complexity of regulation and unsustainable enforcement costs.

2.1.2 Development as Management

The necessity for fishery-resource conservation originates from the industrial, as distinguished from natural, predation of fish stocks. Since that predation is initiated by a demand for fishery products and is intensified by growth in such demand, it follows that fishery management involves the "management" of fishery development.

Supply management in fisheries (often important for successful export trading) presents extreme difficulties but opportunities exist (a) for relating catch quotas to the marketing outlook, and (b) for complementary use of aquacultural production. Movement in the direction of (a) may be politically difficult in some cases, because of a potentially adverse affect on elements of the small-scale fisheries and the communities they support.

2.2 Rational Fishery Management

2.2.1 The Transformation of Common Property

The socially wasteful propensity in the commercial fisheries and their proneness to crises and impoverishment are directly traceable to the institution of common property in fishery resources and open and costless access for resource users. Common property and open access, however, are not inevitable: the conversion of a national property to some form or forms of private property may at times be feasible.

The form suggested is that of a usufructuary right for fishery-resource users, i.e. the right to the use of a state property for individual fishing enterprises (persons, groups, communal organizations corporations, etc.). The right in some instances might pertain to an identifiable discrete stock, in other instances to a share in a total allowable catch (TAC), for example.

Such rights would be granted on a long-term basis and, to facilitate entry, adjustment and exit (except for provision against abuse, e.g. monopolization), they would be freely transferable. By motivating producers to operate at lowest private cost, this arrangement might be expected (a) to optimize net social benefits from the fishery harvest, and (b) to minimize state involvement in regulatory activity in the fisheries.

2.2.2 The Rationalization of Mature Fisheries

Application of the "ideal" approach just outlined, as an institutional innovation, is likely to encounter formidable obstacles in the real world, e.g. opposition from entrenched interests, social inertia and political sensitivity to the disruptive impact of change.

There are practical difficulties as well to be overcome, e.g. accommodation of all existing participants in a fishery, adjustment to variation and vagary in resource (stock) availability, adaptation to multispecies stocks (typical of tropical waters) and prevention of cheating (under-reporting of catches).

A regime of usufructuary or similar quasi-property rights in fisheries, therefore, may have limited applicability at present. Among alternatives, only a state (or a regulated private) monopoly might realize the benefits of such a programme or most of them.

A provisional approach would be a simple entry-control programme, which, under certain conditions, might be managed so as to minimize the potential for erosion of social benefits intrinsic in the struggle among fishing enterprises for resource shares. The collection of a royalty on fish landings would (a) dampen the tendency toward wasteful investment and practices, and (b) return to the public a proportion of the resource rent generated under closed entry.

2.3 Management Planning

2.3.1 Definition of Goals and Policy Objectives

Policy making for fisheries embraces not only industrial regulation, which is complex enough, but also trends and events in other areas of national policy that impinge on the fishing industry and the fish trade, e.g. foreign trade, public finance and social affairs. Integration of governmental planning across a wide front, therefore, is of great importance.

Planning and policy making, like the execution of policy, is essentially an activity of institutions (as opposed to individuals). The key role is that of the executive, i.e. the political head of bureau or agency who, however, requires the support of competant policy analysts as advisers. A common impediment to efficient performance of the analytical function, in developing countries more particularly, is the lack of an adequate knowledge base. A priority for establishment of the necessary research and data-gathering services is thus indicated.

Planning involves, among other things, (a) the setting of goals, i.e. articulation of society's aspirations, a basically political contribution to the policy-making process, (b) a restatement of those broad aims in operational terms for fishery-management and development purposes, and (c) definition of goal priorities or policy objectives. Recognition of conflicts among objectives and evaluation of the necessary compromises or trade-offs become imperative at this point.

2.3.2 Strategies, Tactics and Adaptation to Change

Few objectives have universal validity. Customarily, they differ from country to country and change over time, in accordance with (a) the prevailing value system, e.g. with respect to income distribution in society, and (b) the particular stage of development of a country's fisheries. In so far as possible, action in the present should not foreclose options for the future.

It is important too that the strategic phase of planning not be neglected. Strategies provide the guidelines without which tactical planning (the design of specific programmes) is liable to be misdirected and wasteful. Since they are intended to assure attainment of policy objectives, strategies must be devised to conform with the particular requirements and circumstances of a country's fisheries.

Equity and effectiveness in the execution of policy require (a) that the framework of rules and regulations be reasonably stable and predictable, (b) that such rules and regulations be the least necessary and interfere as little as possible with the economic interests of those affected, and (c) that they be applied with due flexibility. That policy makers and administrators be seen to be responsive to the needs of interested groups is an urgent requirement also. Appropriate channels therefore must be provided (a) for the receipt of client input to the planning process, and (b) for the evaluation of programme impacts.

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1. THE COMMERCIAL FISHERIES [1/] AS A SYSTEM

1.1 Preamble

Let it be agreed at the outset that the term Fishery Management is to be defined in a broad sense. Policy making in this field is not concerned simply with the conservation of natural resources, i.e. stocks of fish species in bodies of water. It is occupied as well with development of the fishing industry and the fish trade.

The central objective of fishery management in this sense is optimization of net social benefits derivable from the use of natural resources. Achievement of the objective involves trade-offs among benefits, e.g. between expansion of employment opportunity and enhancement of individual income or between higher returns for producers and lower prices for consumers. The conditions under which such trade-offs occur differ from place to place and change through time.

This is the source of the major issues in fishery management that confront policy makers and administrators. The "system" within which these issues are presented consists of natural resources as one dimension and product markets as another, the connection between these being provided by the primary (harvesting), secondary (processing) and tertiary (marketing or distribution) divisions of the commercial fisheries. It is an open system, with numerous linkages to other sectors of the economy.

1.2 Component Structure

1.2.1 The Resource Base

This constituent of the system consists not only of the actual resource endowment, i.e. stocks of fish species, but also of the aquatic environment or habitat occupied by and sustaining those stocks. Protection of the integrity and productivity of this habitat is an indispensable condition of successful fishery management. Habitats are subject to the impact of both internal and external influences. Natural variation in environmental conditions is always a hazard and on occasion can be devastating for a fishery, e.g. a shift in ocean currents that alters unpredictably the migration pattern of a species stock. An increasingly common external threat arises from accidental oil spills: hydrocarbon products and chemical clean-up agents are lethal to fish in adult as well as larval stages, either directly or through the food chain.

Environmental degradation has especially severe effects in the most productive and fragile areas of habitat, i.e. estuarine waters and wetlands (foreshore). The principal concentrations of human settlement and industrial activity tend to be located in the vicinity of these areas and progressively to encroach on them. Consequently, major threats to resource survival arise (a) from silting, (b) from the discharge of organic contaminants (from sewage works, packing plants, etc.), of mine tailings, of chemical pollutants (pesticides, herbicides, etc.) and of waste heat, and (c) from the long-term accummulation of heavy metals and other toxic detritus of industrialization.

To a degree, the toll exacted by such competitive demands on marine and freshwater environments is probably inevitable: being part of the price of economic development. The damage, however, may be minimized through an integral approach to fishery management, as discussed later, and, in some cases, offset by means of positive action to restore and/or enhance fish stocks, e.g. habitat renewal, aquacultural projects, etc.

1/ The term "commercial" fisheries, as employed in the present text, contrasts with those of "subsistence" fisheries and "recreational" or "sports" fisheries. It applies to all activities directed to the capture and utilization of fish for sale, regardless of scale and equipment. This usage differs from that of some other writers, who employ "commercial" fisheries as a synonym for "industrial" fisheries in which large-scale or advanced technologies are used, in contrast with "artisanal" or "small-scale" fisheries.

Research in fishery resources has a relatively long history and, although (from a global viewpoint) grievous deficiencies remain, much relevant knowledge has been acquired. In large part, however, it is knowledge for specialists, e.g. officials charged with the design of regulatory programmes or the negotiation of resource-sharing agreements. Of principal interest here is what the generalist must know for effective decision-making at the political level of policy formulation.

The first thing to be said is that fishery resources are renewable but finite. This statement is not negated by the possibility of aquacultural enhancement of certain resource stocks, because the habitat available for that purpose is finite. Recognition and acknowledgement of the finiteness or exhaustability of fishery resources is a comparatively recent phenomenon and the concept may be resisted still in some quarters. It is, nevertheless, an indispensable ground for rational management policy.

It is perhaps necessary also to insist that internal (predator/prey and competitive) relationships within resource ecosystems are highly complex, as are external relationships with the aquatic environment. In neglect of this rule there lies a deadly trap for those who might be inclined to resolve management issues on the basis of superficial analyses. History is replete with instances of serious and even irreversible depletion of resource stocks as a result of simplistically based management policy.

The nature and extent of the resource base thus becomes the first constraint on the achievement of fishery-management objectives. For intelligent decision-making in this respect, some grasp must be obtained of the following:

(a) The magnitude and behavioural characteristics, i.e. seasonal concentrations, migratory patterns, etc., of a given species stock or stocks (biomass), including multispecies (intermingled) stocks.

(b) The way in which the stock(s) vary in response to natural (environmental) forces and to alternative levels of exploitative intensity, i.e. fishing pressure.

(c) The manner in which the exploitation of a particular stock interacts with that of others in the same ecosystem.

(d) The optimal catch rate and level, hence size and density of biomass, for the fish-harvesting industry.

(e) The effect of alternative allocations of access to a particular stock, among competing user groups, on the total quantity harvested, the catch rate and the unit size (age of individuals of the species) caught.

(f) The possible trade-offs among total catch, catch rate, catch stability and unit size.

(g) The maximum yield (catch) from a biomass, i.e. stocks in an ecosystem, that is sustainable over time (MSY).

The last-mentioned, being indicative of the "peril point" in fishing intensity, is a necessary datum for intelligent management planning. Possibly because of its conceptual simplicity or uncontroversiality, and thus its general acceptability, the MSY formerly was adopted as the target at which management policy should aim and this notion may be entrenched in some international conventions even yet. In ecological, not to mention economic and social, terms, the concept is not very meaningful and, in recent literature on marine biology relative to fishery management, it has been abandoned in favour of a more conservative formula.

The operational inutility of MSY is strikingly obvious in the case of intermingled resource stocks, characteristic of tropical and sub-tropical waters. Catches from such stocks usually consist of a large variety of species and year classes. The range in commercial value (price) is equally wide: there is often a sizeable proportion of "trash" fish in these catches. Whatever may be the possibility of selectively fishing a mixed stock (by means of adjustments in the gear used, for example), it seems

probable that maximization of the sustainable yield would imply (a) exploitation at a low trophic level, i.e. non-optimal production in terms of market acceptability, and (b) changes in the species composition of the catch that might be irreversible. In any event, it is clear that optimal rates of resource exploitation are indeterminate on the basis of biological analysis alone.

Among alternative optima, that of a maximum sustainable surplus of revenue over cost in the fisheries (MEY) would maximize the economic benefit for society. There are social benefits, however, that are not necessarily realizable from the maximization of economic efficiency, as strictly understood. These include the creation of employment opportunity and the improvement of income distribution. Modification of the MSY and MEY in these directions results in the (rather awkwardly phrased) concept of optimum social yield (OSY). This defines the quantity and kind of inputs and outputs (catch) by which all the benefits referred to are optimized.

A peculiarity of fishery resources is that in general they are what is called, for want of a better term, common property. This means that, in accordance with the "rule of capture", a quantity of fish from wild resource stocks becomes personal or private property, e.g. that of a fishing enterprise, only when removed from its natural habitat, i.e. caught and landed. Until the advent of extensions of fishery-management jurisdiction by a majority of coastal states, most marine fishery resources were the common property de jure of the world community - some still are and many of these are likely to remain so.

Extension of national jurisdiction over the use of fishery resources within the 200-mile economic zone of coastal countries in effect converts these resources into national (as distinguished from international) common property. The implications of this event, however, are unclear. Although a number of coastal states have been acting for several years as if they possessed a proprietory right in the high-seas fishery resources within their respective zones of jurisdiction - and, for stocks of anadromous species, even beyond those zones - this right is by no means universally acknowledged. There are grounds, however, to suspect that new international law on this subject is in the course of formation. It may be a question of time only until the exclusive authority of nation-states to dispose of the fishery resources of their economic zones is firmly and unequivocally established.

In what follows, it will be assumed that national governments have as free a hand to control the use of the marine and freshwater fishery resources of their respective economic zones as they do those of the lakes and streams wholly enclosed within their borders. The marine resources referred to normally would be restricted to stocks of sedentary, demersal and pelagic species that are found exclusively inside the boundaries of the zone in question. With respect to stocks of similar species that straddle zone boundaries and of pelagic or wide-ranging species that migrate into or through its zone, a nation's authority naturally is circumscribed. As in the case of obtaining access to the coastal zones of foreign countries for distant-water fleets, negotiation with the other country or countries concerned, on the allocation of shares, is necessary in such cases. Unlike past arrangements under international-commission management, however, the allocation should be on a long-term basis. Once agreement on sharing is reached, a country's quota becomes a form of national property.

The position as regards stocks of anadromous species is somewhat ambiguous. The country-of-origin's claim to the sole right of harvest for these stocks is based on the social cost of production, i.e. the value of alternative forms of development (power generation and the like) forgone to preserve watersheds and estuaries for the rearing of anadromous stocks. In some instances, however, such stocks mature in international waters or even in the coastal zones of other countries. It might be argued, therefore, that when this occurs the country of origin owes a share of the harvest or at least a pasturage fee to the international community or to the foreign country or countries involved.

Negotiation for the sharing among nations of the harvest of fishery resources gives rise to some of the most difficult and vexatious of fishery-management problems - problems that are rivalled only by those arising from the intra-national allocation of access among competing economic groups in the commercial fisheries. The difficulty in both cases stems from the existence of differences in the "opportunity cost" of production factors: capital, labour and intrepreneurial skill or initiative. These differences are magnified in an international context because of wide variation from country to country

not only in opportunity costs but also in value systems. In these circumstances, there is no common ground for optimization of input or output in resource harvesting. Agreement as to shares in the harvest, therefore, may be enormously difficult.

Resolution of the issue is not helped by LOS principles unfolded up to the present. According to these principles, as generally understood, it is stipulated that any proportion of a total allowable catch (TAC) from stocks individually or in the aggregate that is not harvestable by the domestic fleet(s) of a coastal state be made available to the fleets of other countries that are capable of using it. The trouble is that the concept appears to have been developed purely in physical (biological) terms. As we have seen, optimal levels of harvesting and consequently the presence or absence of potential "surpluses" must be identified by means of an analysis that incorporates economic and social as well as biological factors.

Analytical sophistication of this kind is rarely available, unfortunately, and in its absence political "horse trading" must serve. In negotiations of the latter type, account would be taken of broad national interests (including, possibly, those outside the fisheries sector), e.g. the expansion and/or diversification of product markets, to be considered later, the sourcing of investment for general developmental purposes and other policy objectives.

1.2.2 The Primary Fishing Industry

The primary division of the commercial fisheries consists of all enterprises 2/ engaged in the harvesting of fishery resources. Organization varies widely, in accordance with (a) historical evolvement, (b) the socio-economic environment, and (c) national developmental policy. In capitalist (market) and mixed economies, for example, fishing enterprises generally are privately owned and operated. Typically they exhibit enormous heterogeneity in form, size (extent of investment and numbers employed), type of equipment and pursuit (species caught, grounds fished and so on).

A traditional feature of organization, typical of commercial fishing enterprises in many parts of the world, is remuneration of crew members (as co-venturers with the owner) on the basis of individual shares in the proceeds of the catch. Sharing formulae usually vary with scale of enterprise, i.e. the larger the investment, the lower the labour share proportionately. With unionization, arrangements of this kind are being replaced by basic rates of pay, e.g. per trip or per season, plus productivity bonuses. Where port markets function effectively, e.g. when landings are sold at auction, fishing enterprises are predominently independent, i.e. untied to processing or trading entities. In other circumstances, groups of such enterprises may form a producers' co-operative to engage in processing and product marketing or a processing and/or trading company may acquire a fishing fleet. 3/

In traditional, e.g. tribal, societies, fishing often is a communal affair, carried out for subsistence or commercial purposes or both. One finds a somewhat similar arrangement, i.e. the production brigade, in certain developing countries that have adopted a centrally directed economy. More commonly, perhaps, state enterprises (ressembling, in organization, the larger integrated fishing enterprises of market economies) predominate in the fisheries of socialist countries. Theoretically,

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2/ Throughout this text, the object or focus of fishery regulation is identified as the fishing enterprise, i.e. the entity responsible for investment, employment and operational decisions. A number of authors of papers on the same or related subjects, finding that usage somewhat "clinical" in tone, perhaps, prefer to use "fisherman" for this purpose, although a distinction sometimes is made between vessel owners and crew members.

3/ Vertical integration, of which these are examples (forward and backward, respectively), also occurs in agriculture and other industrial sectors.

when operating within national zones of jurisdiction, these latter should not be subject to the blight, described below, affecting enterprises that operate in a competitive milieu. They might well be so affected, however, as participants in international fisheries where a free-for-all prevails.

In both advanced and developing economies, the primary fishing industry often exhibits a dual structure, i.e. two more or less distinct segments, respectively designated small-scale or artisanal and large-scale or industrial. The terms refer to the size and/or sophistication of the technology (fishing craft, gear and other equipment) employed by the enterprises involved. A relatively wide difference in size of investment and number of persons engaged per enterprise is also implied: the range extends from one man with a canoe (or equivalent) to a factory ship crewed by several hundred.

The small-scale segment tends to be distinguished from the large-scale one in other respects. In most cases, the former represents the traditional fishery or fisheries of a region or country. As such, it is often technically stagnant and dispersed in small and remote rural communities scattered along the coastline. Access to fishing grounds is restricted, by the types of technology commonly in use, to a comparatively narrow strip of coastal waters. Economies of scale, e.g. in the procurement of inputs and the marketing of catches, seldom are realizable. In contrast, large-scale enterprises are likely to be centred on a few large ports, to be footloose in operation and to command the industrial, business and financial services of an urban community.

The stark dichotomy, suggested in the preceding paragraphs, between small-scale and large-scale segments of the fisheries in fact is an over-simplification. It appears to be real enough in some developing countries but elsewhere reality is better represented by a continuum: there being, between the smallest-scale and the largest-scale technologies in use, a number of intermediate-scale technologies and related sizes of enterprise.

Moreover, this may indicate the direction of development. Events of the recent past, e.g. the rise in energy cost and the establishment of EEZs, have transformed the outlook for enterprises at both ends of the range. The use of smaller-scale technologies is offered much greater scope, potentially at least, while some of the largest scale technologies, the vessels required for distant-water operations and possibly factory-ships in general, have become or are becoming out-moded. Movement toward an optimal fleet mix, optimizing the types and quantity of technologies in use (with a probable leaning toward smaller-to-intermediate ones) would be expedited by the institution of regimes of quasi-property rights for fishing enterprises, as considered later.

As mentioned earlier, common property in the natural resources is a pervasive feature of the commercial fisheries throughout the world. Indeed, not only may fish stocks be so catagorized but their aquatic habitat usually is common property also and, as such, liable to claims from other uses, e.g. for navigation, recreation and waste disposal. Associated with the peculiar institution of common property, in most countries, is the further peculiarity that access to the use of fishery resources traditionally has been open to all. The exceptions to this rule, e.g. the allocation to individuals and communities of an exclusive right to the use of fishery resources in their proximity, are relatively rare. Moreover, excepting the investment required for entry, access to the use of fishery resources usually has been costless or, at the most, subject to a token licence fee.

The combination of common property in fishery resources and of open and free access for resource users has profound consequences. Having no security in the resource base, the proprietors of a fishing enterprise can assure themselves of supply, i.e. a catch share, only through aggressive action on the fishing grounds. That is, within their financial competence, they must seek to excel in technical efficiency. Since entry is unrestricted and all enterprises are similarly motivated, additional investment and manpower are continuously attracted to a fishery so long as the "opportunity" incomes of these factors (going interest and wage rates) are being matched therein. The tendency is reinforced by evidence, always to be observed: (a) that "bonanza" catches occasionally are obtained, (b) that, as beneficiaries of "fisherman's luck" participants sometimes make windfall profits, and (c) that, being managed with unusual skill, some enterprises continue to operate successfully (earn quasi-rents) year in and year out.

The benefit to society of an economic activity is maximized when the difference between the value of output and the cost of inputs required to produce that output is at a maximum. Given secure property rights for producers and reasonably efficient markets, this result is brought about more or less automatically through the competitive action of producers seeking to maximize their individual returns. The paradox of the commercial fisheries is that, without property rights in the natural resource, competition (rational behaviour, that is) among producers leads not to maximization of the net return to society but to the reduction of society's return to zero. Far from generating an economic surplus, the yield of a fishery actually may be negative. When that happens, the fishery becomes a liability to the regional or national economy and a drain on the surpluses yielded by other sectors. 4/

Where fishing operations are relatively labour-intensive and alternative employment opportunity is scant, i.e. the opportunity cost 5/ of labour approaches zero, the private cost of entry usually is low and the potential for the expansion of labour into a fishery is high. When labour is the scarce factor, on the other hand, fishing enterprises tend to invest excessively in fishing craft, gear and other equipment. 6/ In either case, the ultimate result is total dissipation of the surplus (rent) that exploitation of fishery resources is capable of generating and that, in other circumstances, might accrue in whole or in part to the resource "owners", i.e. society in general as represented by the state.

The inexorable propensity to over-expansion and congestion pervades the commercial fisheries wherever the specified conditions of open access and common property in resources exist. It is sufficiently powerful to nullify alike the effects of a rise in product prices and those of a fall in production costs, e.g. as the result of a technological breakthrough. Consequently, mature fisheries everywhere are susceptible to recurrent crises, characterized by widespread economic distress, e.g. capital losses and declining incomes, dramatically illustrative of what has come to be known as "The Tragedy of the Commons".

Disaster is liable to fall with particular severity on the small-scale segment of the fisheries. In some countries, engagement in small-scale fishing may be an occupation of last resort and be combined in complementary fashion with a variety of other occupations. Furthermore, under open-access conditions, the dynamics of entry and exit in this segment are notably asymmetic: entry is relatively easy and exit may be quite difficult. Impediments to withdrawal include (a) difficulty in the liquidation of assets from a declining fishery, (b) obligations to buyers and lenders (chronic indebtedness), (c) the cost of retraining and resettlement, (d) attachment to a native life-style, (e) isolation from and a lack of knowledge of and/or preparation for alternative employment, and (f) absence of an attractive or any opportunity for relocation and reemployment. As a result of all that, over-crowding with its attendent evils, e.g. general impoverishment, is especially acute in small-scale fisheries. In times of crises, then, incomes may quickly fall and remain below the opportunity level.

A concomitant baleful consequence of open access to the use of a common property is endangerment of the fishery resources involved. Fishing enterprises are led, because of the fiercely competitive forces impinging upon them, to circumvent and subvert measures designed to protect or conserve resource stocks. Pressure is brought to bear on regulating authorities to remove or relax

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4/ This is true despite benefits of other types that society is alleged to obtain from the mere existence of a fishery or fisheries, e.g. employment and an abundant supply of fish protein at favourable prices ("consumer's surplus"). Under the assumed conditions, the waste of capital and labour resources in the fisheries implies that production generally (including food production) and consequently consumers' surplus are less than, and employment is no greater than, they otherwise would be.

5/ Opportunity cost is defined as the most favourable price that can be commanded by a factor of production; it thus tends to become the lowest cost at which that factor can be obtained (purchased) by an entrepreneur.

6/ Under restricted-entry regulation, unless the resource rent accruing to the privileged enterprises is appropriated by management authority, the process of "capital stuffing", as it is called, may extend to investment in luxury and ostentation as well as in advanced technology.

controls, e.g. to open seasons prematurely, to extend seasons and catch quotas, to permit entry to nursery areas, to withdraw or modify gear regulations, i.e. those relating to lengths of line, size of hooks, mesh-sizes in nets, etc., or to enfeeble the application of such regulations and so on and on. Collectively, fishing enterprises have an all-important stake in the health of the natural resources on which their existence depends. Individually, however, they are compelled to behave in utter disregard of this vital concern.

The fundamental divergence between individual and collective interests is the underlying source of much inter-group conflict in the commercial fisheries. Such conflicts, e.g. so-called "gear conflicts", represent probably the most intransigent problems confronting fishery management. The term embraces conflicts among a variety of economic groups, e.g. between vessel-owners and crews (over shares in proceeds), between enterprises which use small-scale and those which use large-scale technology to exploit the same stocks at different points (inshore and offshore, respectively) in the biological cycle, between different regional groups that depend on the same market (where the supply from one may depress the price obtainable by another) and between domestic fleets and fleets from foreign countries. All are ultimately attributable (a) to the fact that, at a mature stage of development, the primary industry's capacity to produce far exceeds the capacity of available resources to sustain production, and (b) to the not unrelated fact that fishing as traditionally managed resembles a "zero-sum" game, i.e. a gain for one enterprise or group of enterprises implies an equal loss for another enterprise or other enterprises.

An unhappy outcome of this discord is that governmental authority, under pressure to reconcile the contending groups and protect them from one another, frequently is enticed into encasing the industry in a minutely specific and increasingly complex web of regulations. This is calculated, not only to frustrate efficient utilization of the natural resource, but to create strongly vested interests in the status quo. The latter effect has been described as a tendency toward profound inertia in the fisheries, i.e. participants, having adapted to the existing regulatory regime, tend to view with suspicion and to resist any proposal for change. The opposition thereby engendered is not infrequently a major obstacle to innovation in fishery regulation.

1.2.3 The Fish Processing Industry and the Fish Trade

These, the secondary and tertiary divisions of the commercial fisheries, are not always separable. Where distances from points of landings to centres of consumption are short and, as often in tradition-oriented communities, consumers prefer to obtain undressed or minimally dressed fish, the processing phase may be by-passed more or less completely. To the extent that processing does take place, it is performed by fishermen themselves or by vendors at dockside or at central marketplaces. Generally speaking, an advanced degree of processing and packaging, including the operations of filleting, freezing, curing, canning and the preparation of by-products, is required (a) when fish must be stored for long periods, (b) when market outlets are situated far inland, and (c) when products are exported to other countries.

The necessity for prolonged storage reflects a disparity between market requirements and supply availability. This may be (a) inevitable, i.e. attributable to the catch being based on stock concentrations of short duration or to consumption being concentrated annually by social or religious custom, or (b) wholly or partly avoidable, i.e. attributable to disorganization and/or the use of inadequate technology in resource harvesting. Distance between landing ports and distribution centres in the hinterland is largely a function of the size of a country and the service of export markets becomes an objective when supply, in the production of which a country possesses a comparative advantage, substantially exceeds the absorptive capability of the domestic market.

Where the three divisions of harvesting, processing and marketing (trading) are well developed and clearly identifiable, there may still be a marked separation of the first from the latter two. The port market, despite its effectiveness frequently being blurred by (a) financial ties between fish buyers or middlemen and fishing enterprises, e.g. the powerful "fish mammy" institution in certain regions, and (b) types of vertical integration as already indicated, usually separates the primary from the other two divisions of the fisheries quite distinctly. There may be no such clear-cut distinction between the latter

divisions. Instances of integration forward, from processing through wholesaling to retailing (in export as well as domestic markets) may occur and the larger firms in both divisions may be closely associated through interlocking arrangements of various kinds.

Economies of location and scale in fish processing are important but generalization on this aspect of the subject is difficult. Some of the relevant factors are site specific. Proximity to raw-material sources, i.e. the fishing grounds, unless a factory-ship operation is contemplated, is an obvious consideration. Other determinants of location include the availability of power and a trained labour force and the presence of transportation nodes (where shipment to distant markets is involved). Economies of scale in processing typically are realized at a fairly modest throughput capacity (possibly as little as 10,000 tons raw fish/year). Scale is more significant with reference to business organization (for financing, bulk purchasing of supplies and market service) and to the conduct of research and development. Hence the prevalence of the multi-plant firm (horizontal integration) in this division of fisheries.

As compared with "industrialized" fish harvesting, i.e. harvesting by fleets using large-scale technology (in contrast with the artisanal type of operation), fish processing is relatively labour intensive (in some cases a ratio of 3:1 is observed). Generalization, again, could mislead. When throughput units (individual animals) are uniform in size or when size is irrelevant, as in reduction processes, mechanization is feasible. Otherwise, manual operations (for dressing, skinning, filleting and the like) are necessary. The choice as between the use of manpower and machines depends in general on relative costs (based on wages, rentals, permissible write-offs and so on).

While the fish-processing industry and by extension the fish trade are not subject directly to the pressures (stemming from open access and the use of common-property resources) that impinge on the primary industry, the processing division especially may not be immune to an analogous tendency toward over-expansion. Over-expansion and the associated over-crowding of the primary industry often lead to widespread dispersion of operations and an accompanying increase in the seasonal peakedness of fish landings, i.e. the raw material for the fish-processing industry. In adjusting to this trend, firms in the latter division are induced to install additional facilities (branch or "feeder" plants) and/or additional firms enter the industry. The resulting emergence of redundant processing capacity sometimes is fostered by governments, anxious to expand employment opportunities and maintain sales outlets for primary producers, through provision of incentives, e.g. construction subsidies, and (from a rational viewpoint) superfluous infrastructure.

Since the entry of additonal firms in the processing division tends to fragment trading operations, the fish trade may be affected as well by the developments just described. Where the export of fishery products is important for the growth and success of the industry, fragmentation in trading activity may be a serious weakness. By encouraging intra-trade competition, for example, it reduces the trade's ability to compete with powerful rivals in export markets. In certain circumstances, e.g. a downturn in the business cycle, this debilitating tendency may be countered by mergers among private firms or, failing that, the government concerned may intervene to consolidate export-trading operations by regulation (licensing and the imposition of entry criteria) or by creation of a state trading agency.

1.3 Linkages and Interdependence

1.3.1 Factor Supply

To appreciate the ramifications of fishery management and development policy, an understanding of the interdependent relationships between the fisheries and other sectors of the economy is necessary. The commercial fisheries interact with both factor and product markets, through backward and forward linkages, respectively. Factor markets are the source of inputs to the fisheries. Such inputs consist (a) of investment funds, for infrastructure, fishing craft and gear, plant and equipment and capital assets generally, (b) of working capital, to finance payrolls, product inventories and the like, (c) of labour time (the effort of individuals), and (d) of entrepreneurial talent and initiative (the integrating function).

The sources of investment funds for fishery development are the private financial institutions of a country and the state government. Because of the high degree of uncertainty attending the outcome of fishing operations and not infrequently, perhaps, ignorance on the part of the financial community of the particularities of fisheries, this sector sometimes is unattractive to private sources of venture or equity capital. Furthermore, since (a) fishing enterprises lack a property right in the resource stocks on which they depend, and (b) fishing craft often are highly specialized, i.e. have little value outside the fisheries, the security required by private banks for loans and advances often is difficult to provide. Small-scale fishing enterprises in particular, especially in parts of the developing world, are reported to be at a disadvantage in this regard and, in consequence, often are vulnerable to exploitation by "informal" suppliers of credit. Fragmentation and small-scale enterprise tend to cause similar problems for firms in the fish-processing industry and the fish trade.

For that reason, even in private-enterprise economies, one finds governments intervening to complement, supplement or replace private sources for the financing of business enterprise in the commercial fisheries. The programmes designed for these purposes take the form (a) of guarantees for the investment and lending activities of private institutions, (b) of special investment and loan funds, managed by state agencies, and (c) of subsidies of various kinds for fishing enterprises and small-scale business. There is a powerful tendency, unfortunately, for such programmes to become unnecessarily rich and to exacerbate the inherent leaning (already noticed) toward over-expansion in the primary fishing industry especially.

In addition to operational inputs, e.g. gear, fuel, bait, ice, salt, etc., which fishing enterprises are expected to provide from their own resources, there are certain capital inputs, fishing craft (vessels and boats) being the major item but also including engines and winches, for example, which are sometimes impracticable for barely viable enterprises to finance. These are the objects that attract subsidization. Grants, bounties and concessionary loans, as apparently facile means of compensating for capital-market imperfections, have a seductive appeal for administrations. Subsidies tend to get "built into" an industrial structure, however, and survival of the beneficiaries may become impossible without them. Extrication from programmes of this kind, therefore, is notoriously difficult and they tend both to distort investment in the fisheries and to be a perpetual burden on a country's taxpayers.

Because many components of fishery-related infrastructure produce collective goods, e.g. establishments for scientific research and for education and training and navigational support facilities and harbour works, governments assume responsibility for their provision almost everywhere. Some of the responsibility however, may be shared. A capability for research in product innovation and market development, for example, is largely a function of operational scale and is easily within the capacity of the larger private firms in the fisheries of some countries. Private companies may also have a role to play where training "on the job" is essential for the acquisition of certain skills in fishing and fish processing.

Excepting those areas where small-scale (artisanal) operations predominate and fishing craft are "homemade", linkage with the shipbuilding and boatbuilding industry is probably the major backward linkage from the commercial fisheries. Fishing boats and vessels constantly are being repaired, upgraded and replaced. The useful life of even the larger, technologically sophisticated types of craft usually does not exceed 20 years. As the industry evolves, in the direction of greater specialization or in that of greater versatility (multipurpose fishing) as the case may be, new designs and technologies are introduced. Currently, there are trends toward (a) construction with fibreglass, ferro-concrete and aluminium - materials which have a longer life span, are less expensive to maintain and in some cases are lighter and more readily available than the traditional wood and steel, (b) selection of propulsion technology and propeller design for greater energy efficiency and manoeuvrability, and (c) optimal combination of craft size, horsepower and gear used, to facilitate diversified fishing and quality control.

Directly or through intermediaries, e.g. shipyards, shipchandlers and other supply houses, the commercial fisheries are linked to an impressive variety of producers of ancillary goods and services. Possibly as many as 3,000 species altogether are exploited in the world's fisheries, more than 100 in the national fisheries of each of several countries, and the capture and processing of so wide a variety of animals necessitates the devising of a comparable range of techniques and technologies. Some 250

categories of component and equipment may be used in the construction of fishing vessels, for example, and an even larger number of products are known to be consumed each year in fishing operations. Handling, processing and product storage involve equivalent requirements.

A selection of approximately 25 types of product, under five general classes, is shown in an appendix. The list is incomplete and is intended merely to indicate the scope and diversity of manufacturing, fabricating and service industries laid under contribution in the establishment and maintenance of modern commercial fisheries. The availability domestically of these supply sources is restricted largely to countries in an advanced stage of economic development. Most developing countries have to reply initially on imported supplies and/or the transfer of technology by means (a) of joint ventures with entities from technically advanced countries, or (b) of special arrangements, e.g. for aid programmes, with such countries.

Reliance on joint ventures for this purpose may not be always advantageous for the host country, since the interests of the two countries are not necessarily convergent. As formerly prevalent under international open-access conditions, the technologically more advanced fleet may enjoy an unfair advantage in competitive use of shared resources. An alternative arrangement, under which catchable surpluses are disposed of to foreign bidders would enable a coastal state to collect a maximal royalty for the use by other countries of its fishery resources. The proceeds might then be utilized as desired for the acquisition of technology, infrastructure and services to develop the domestic fisheries. The choice among the several alternatives would depend on policy-makers' comparative assessment of developmental prospects and associated costs.

At all events, through the linkages indicated above, the establishment of viable commercial fisheries creates important opportunities in the home market for the output of a range of supportive industries and services. Critical issues relating to economies of scale and the like are involved here, and realization of the opportunities referred to depends, among other things, on those issues being resolved.

1.3.2 Product Markets

In the evolvement of the commercial fisheries of any country, the role of product markets is a leading and decisive one. The initiation, adaptation and expansion of fishery production is constrained by opportunities for the sale of products that may be derived from resource stocks available to the country's fishing industry. Specification of products with respect to type, form and quality is established by market requirements - ultimately in accordance with the preferences of consumers served by the marketing system.

Fishery products fall into two broad categories, viz. food products and industrial products, i.e. fishmeal, oil, etc., the former of which is usually although not invariably the more important. Food products of the fisheries may be classified generically as follows:

Fresh or chilled, i.e. non-frozen (round, dressed, filleted, etc.)
Frozen (untreated, breaded, cooked, etc.)
Cured: smoked, salted, dried, etc.
Canned (plain and variously treated)
By-products: roe, pate, etc.

Market outlets are differentiated according to the class of product demanded - the class normally being differentiated in turn by fish species. Canned products have a relatively long shelf-life (several years), cured and frozen products an intermediate one (months), and fresh products one of a few days or even hours. As a rule, therefore, distant markets cannot be served effectively with fresh fish products excepting certain "luxury" products that can bear the cost of air-freight. The taste of consumers also may dictate the conditions, with reference to intrinsic quality, grading and workmanship, under which fish must be caught and the derived products prepared. If these conditions cannot be met, marketing opportunity is thereby forfeited. When marketability requires that fish be frozen, cured or canned, economies of scale in organization and in processing and trading operations come into play and the size of the product market or markets becomes a determinent of developmental potential and possibilities.

The demand for fishery products is determined in part by cultural history, i.e. it is based on an "acquired" taste, and, as most studies have shown, it tends to be inelastic as to price and income in the short term. To some extent, however, it appears also to be influenced (a) by fashion, e.g. dietary fads, and (b) by the price and availability of both complementary and competing food products. In the more affluent countries, where as much as two thirds of fish consumption is accounted for by the institutional (including hotel/restaurant) demand, as distinguished from the household demand, agregate demand sometimes responds to the rise and fall in general economic conditions. It is therefore, to be regarded as in some degree amenable to manipulative and expansionary effort by producers and traders.

To speak of a demand for fishery products as if they constituted a homogeneous mass is, of course, a serious oversimplification of reality. There exists in fact an almost infinite variety of such products, differentiated by species, processed form, mode of preparation and a host of other distinctions. Products range from virtually perfect interchangeability, e.g. certain (unlabled) canned products of the same species but of different origin, to absolute non-substitutability, e.g. as between food and industrial products. Consumer preferences and demand elasticities for specific products may exhibit a similar degree of heterogeneity within a country and a fortiori from one country or region to another.

The demand for industrial fish products is subject to special factors. That for fishmeal, for example, a component in animal feedstuffs, is affected by the price of alternative additives and responds to the ebb and flow in poultry and pork production. The demand for fish oils, which may be considered by-products of the reduction (meal-manufacturing) process, is affected in an analogous manner. It is generally beyond the reach of the fishing industry and/or the fish trade to influence the demand for these products.

2. MANAGEMENT OF THE FISHERIES

2.1 Introduction

2.1.1 The Involvement of the State

With negligible exceptions, as was explained earlier, fishery resources have been the common property of individual nations or of the world at large. The allocation of rights to the use of those resources by means of a market, therefore, has not been possible. In this situation, governments, acting unilaterally or in concert with other authorities, have been impelled to allocate access among rival claimants. Assuming that, in relation to the claims of other resource sectors, that of fisheries to a specific water body and/or the resources therein has been established, allocation is necessary first of all as between commercial and recreational (and possibly subsistence) uses. 7/ In the absence of a real or a simulated market mechanism, unfortunately, such allocation must be essentially arbitrary. The same is true of the second phase of access allocation, i.e. among individual users (enterprises and/or persons).

In the case of the commercial fisheries, the issues confronting management authorities include the following: 8/

1. Should the objective of management be:
   a) to maximize the number of persons employed in fisheries,
   b) to maximize enterprise revenue, more particularly the earnings of participating fishermen
   c) to maximize a surplus (rent) for resource owners, i.e. the state or citizenry, or
   d) to achieve some desired amalgam of the foregoing?

7/ This does not apply in every instance, of course, but only when anglers (and/or subsistence fishermen) compete with commercial fishermen for access to and use of a specific stock or stock complex.

8/ Subsidiary issues might relate to maximization of protein production or of export earnings.

2. How should existing and potential conflicts of interest among groups sharing a stock or stocks in common be resolved, e.g. as between groups using immobile equipment and those enjoying relative mobility and as between domestic and foreign fleets?

3. How should the mix of inshore or small-scale, nearshore or intermediate-range and offshore or distant-water fishing craft be optimized, with reference to:

   a) harvesting costs of different types and sizes of craft,
   b) processors' requirements for volume and stability of throughput, and
   c) market preferences as to variety and quality or product?

4. What is the preferred pattern of fleet ownership, i.e. independent fishing enterprises vs. vertically integrated (fishing, processing and trading) companies, and how should it be brought about?

5. As competing users of finite natural resources, how may fishing enterprises be induced to conserve society's other resources, i.e. minimize inputs of capital and labour in the fisheries?

In general, it appears that fishery managers have adopted 1.(a) as their over-riding objective, have concentrated on the resolution of issue 2. and have tended to overlook or slight the remaining issues. Management thus has striven to accomplish ultimately incompatible purposes. On the one hand, conservation of resource stocks has been accepted as obligatory. At the same time, maximization of employment in the fisheries requires that open access to stock exploitation be maintained and, as suggested earlier, this can lead to ruinous pressure on fishery resources. Consequently, regulation of the commercial fisheries inevitably becomes direct regulation of inputs to fishing, i.e. regulation of the productive efficiency of participating enterprises. This takes the form of restrictions on the type and size of fishing craft admitted, specification of the kind and quantity of gear used and control of operating seasons and grounds fished.

In application, the approach is often frustrating and sometimes self-defeating. While perfect substitutability of inputs is rare, adaptation on a considerable scale usually is feasible even in the short run: curtailment of permissible vessel size may be offset by an increase in power installed, extra crew may compensate for limitation of power and so on. As a result, fishery regulation tends to degenerate into a process of continuous makeshift design. Regulatory measures become more and more complex and ever more costly to enforce, world without end! The anomalous nature of fishery regulation, as it has evolved over time, may be shown by applying operational rules typical of the commercial fisheries to another resource industry (see Appendix B).

The eventual futility of management in this mode has been obscured by an apparent absence of alternatives, given the constraints on policy imposed by legal precept, political directive and institutional or administrative structure. There is now, however, a growing perception (a) that the conventional approach leads to intolerable enforcement costs, (b) that, because of circumvention and emasculation, existing measures constantly verge on instability and collapse, and (c) that fisheries as traditionally managed are terribly wasteful of social resources.

2.1.2 Development as Management

Fishery management's reason for being emerges in the course of fisheries maturation. Unexploited resource stocks, excepting those serving as forage for exploited stocks, are of little concern to anyone. The need for conservational action originates in the stock mortality resulting from non-natural predation, i.e. commercial (and/or recreational) exploitation. Since fishing activity is generated by an opportunity to market the products derivable from accessible fishery resources, commercial exploitation of such resources is initiated by a demand for those products and is intensified by growth in that demand. In this sense, product markets are the "prime mover" in fishery development and the ultimate source of management problems.

That is not to say that, although guided and constrained by marketing opportunity, productive activity in the fisheries is a passive reaction to such opportunity. In the early stages of development particularly, when issues of economic viability are to the fore, market penetration, diversification and expansion are likely to be the primary concern of policy makers in government as well as in the industry and trade involved. Priority is then placed on demand analysis and, on the basis of that analysis, on ensuring effective and efficient service of market requirements with respect to form and quality of product and to continuity and stability of supply. The relevant issues are as follows:

1. What is the industrial structure and type of business organization, in fish processing and marketing, best suited to developmental needs?

2. To what extent and in what respects do the existing structure and organization fall short of requirements?

3. What are the social and institutional (including legal and jurisdictional) constraints on desirable restructuring and reorganization?

4. How might such constraints be removed and would some or all disappear through time?

5. Are there managerial deficiencies and deficiencies in factor markets that constrain development in desirable directions and, if so, what should be done to eliminate these?

6. What if any role is to be assigned to foreign firms and agencies in this aspect of fishery development?

7. For the assessment of comparative benefits in the latter respect, should the short-term perspective be distinguished from that of the long term?

8. What powers, e.g. in the form of grants of access rights, are at the disposal of the national government in question to influence trends in the international marketplace and how should such powers be exercised?

In so far as the "management" of demand is feasible, it involves matching and if possible bettering the service to customers that is obtainable from rival suppliers. Besides a capability, on the part of the trade and industry, to provide a satisfactory product and adequate supply, as already indicated, this requires sufficient flexibility and resilience to respond effectively to commands of the market for product innovation, adaptation and promotion. Hence the importance of industrial structures referred to above.

At this juncture, it is necessary to stress that, although supply management in the commercial fisheries (in the sense in which it is practised by some agricultural industries) is not totally inconceivable, it is difficult in the extreme. Demand in product markets, as signalled by price, is quite specific with reference to species and quantities. Any congruence or consistency, however, between harvesting requirements so dictated and balanced exploitation of resource stocks in an ecosystem would be wholly fortuitous. This is a major source of the "by-catch" and "discards" problem that so often undo the effectiveness of fishery regulation.

To some extent, supply for the product market may be augmented and/or stabilized by drawing on production from aquaculture. Stocks of certain species of Cyprinidae, Mollusca, Salmonidae and many others are capable of enhancement for that purpose. Since supply from this source is more readily manageable than that from wild stocks, as regards quantity and time harvested, the crop may be combined with other commercial supplies in a complementary manner.

Broadly speaking, there are two types of aquaculture, viz. fish farming (pond and enclosure culture) and fish ranching (in which the crop grows to maturity at sea). In both cases, special provisions of an institutional and legal nature are required to promote development. Fish farmers must be able to

obtain the right to a water column protected from pollution, trespassers and other infringements. Fish ranchers must be assured of exclusive right to their crop, which means that harvesting by others, e.g. on the return migration, must be prohibited. In some instances, e.g. where stocks intermingle, the latter prohibition might be infeasible because of excessive interference with fishing operations based on wild stocks.

While compatibility between harvesting preferences (reflecting those of the market) and optimal resource use is not realizable, in the short term at least, certain second-best objectives are attainable and merit pursuit. Action may be taken, for example (a) to inject an assessment of potential marketability into the setting of annual TACs (total allowable catches) - on the ground that, if the derived products are unsaleable and must be inventoried (stored), it were better to leave the fish in the water, and (b) to restructure the primary industry so as to eliminate or minimize, (i) seasonal peaks (gluts) in supply, and (ii) the incidence of unacceptable, e.g. undersized or low-quality, fish in commercial landings.

Action along these lines, one must point out, may create a political dilemma for the management authority. Especially when the industry is heavily dependent on export markets, competitive efficiency is likely to be imperative for successful development and continued viability. When the domestic market mainly is to be served, the issue is less critical but far from trivial: inflated cost in the supply of food would imply a transfer of income from consumers to producers which might be undesirable from a policy viewpoint. If efficiency in product supply were to be maximized, however, the presence or persistence in the industry of economically inefficient units, i.e. fishing enterprises, processing firms and trading companies (and components of these), could not be tolerated.

Removal of such units and operations, on the other hand, whether it were my means of administrative fiat or as a result of the harsh impact of market forces, may well prove to be exceedingly difficult. Certain elements or features of inefficiency, e.g. seasonal "bunching" of landings (raw-material supply), wide variation in quantity landed (season to season), insufficient variety in the species mix and inconsistent quality of product, are associated in many instances with excessive dependence for supply on an outmoded or inadequate technology, i.e. the relatively immobile fishing craft and gear typical of small-scale or artisanal enterprises. At the same time, as the commercial fisheries have evolved in some countries, small-scale fishing enterprises and the "superstructure" erected on their operations, i.e. fish processing and/or the fish-trading business, constitute the sole or major economic base of whole communities and regions. In such circumstances, a rapid or drastic restructuring of the industry and trade is out of the question - often, because of unacceptable social or cultural repercussions, any action whatever in the direction of "rationalization" is virtually impossible.

Although grim, a situation of this kind is not absolutely hopeless. For one thing, that small-scale implies inefficiency is by no means a universal rule: in certain conditions, small-scale technology and operations are optimal economically - the important point is to determine when and where this is so. Moreover, as the basis of a traditional culture or way of life, small-scale fishing and the communities it supports sometimes enshrine social values that are not necessarily inferior to the technocratic ones espoused by the more bemused of economic planners and developers. Rather than being an insufferable frustration of progress, then, the necessity of postponing the achievement of some policy objectives and rescheduling programmes of modernization may in fact present an opportunity for a reassessment of objectives and for a redirection of planning toward more realistic approaches to fishery development.

2.2 Rational Fishery Management

2.2.1 The Transformation of Common Property

As we have seen, the conventional mode of fishery management leads to the following lamentable state of affairs:

1. More or less universal congestion and an accompanying waste of social resources, particularly in the primary fishing industry, i.e. inputs of these resources exceeding (often grossly exceeding) the quantity necessary, with given technology, for economically efficient harvesting operations.

2. Consequent pressure on the natural-resource base, a pressure that verges constantly on the uncontrollable.

3. Compulsive intervention by government to conserve the resource base and to mitigate the inevitable effects of over-crowding and waste in the primary fisheries, i.e. recurrent crises and impoverishment of participants.

As explained, governmental intervention takes the form of measures (a) to control output (quantity harvested), e.g. catch quotas and seasonal or ground closures, usually on a discrete-stock basis, (b) to regulate input (fishing power), e.g. restrictions on type and size of fishing craft, on type and effectiveness of fishing gear and finally on numbers of entrants, and (c) to provide financial support for enterprises and individuals in crisis or adversely affected by regulation, e.g. construction and price subsidies, income supplements and the like. The regulatory measures mentioned tend to become progressively more restrictive and more complex in application. Those relating to surveillance and enforcement, especially, become intolerably costly - beyond the horizon for poorer countries. Supportive measures also, income supplementation in particular, are subject to increasing cost. Moreover, to use an extravagant under-statement, the results are unsatisfactory for nearly everyone concerned. Is there no alternative?

In answer to that question, it is necessary first to specify the fishery-management problem as precisely as possible. The salient characteristics of the resource base, i.e. volatility, non-tangibility and interactivity, are well known. In consequence, the sources of uncertainty confronting users of fishery resources are unusual in extent and variety. All business activity is subject to uncertainty, however, and in this respect the fisheries differ from other resource-based industries only in degree. It is well known also that, with minor exceptions, fishery resources are common property and it is generally supposed that this institutional peculiarity is inherent in the nature of such resources. Yet society has contrived to create forms of private property in land and mineral resources, e.g. hydrocarbons, which share a number of features with fishery resources. Furthermore, resources that were once common property, e.g. grazing lands and the open range, are so no longer.

Herein lies the crux of the management problem. The socially wasteful propensity in fisheries and proneness to crises are directly attributable to competition among fishing enterprises under conditions of open access to the use of natural resources, to which none can lay claim and for the husbandry of which none are individually responsible. This is not a recent insight. More than a hundred years ago a fisheries official in Canada wrote as follows:

> "... the occupancy of salmon stands under formal title enables the occupiers to economize both their own capital and labour and the public property in salmon. Where the fishery is carried on ... under such incitements to excess as are created by contentious rivalry and the prospect of mere temporary gain, it is extremely difficult to control fishing operations within reasonable bounds. But, on the other hand, where occupants can rely on the permanence of their holdings, and enjoy in successive years the benefit of their own moderation in each preceding season, the Department finds very little difficulty in controlling the pursuit." 9/

Supposing it were possible to dismiss precedent and, without prejudice, to manage fisheries for the optimal benefit of society and the nation: how might this be done rationally? To begin with, it would not be necessary to take common property in fishery resources as given. This point might be disputed by legal experts, e.g. the common law of England and certain other countries does not recognize ownership of wild animals in their natural state. Nevertheless, as has been indicated, a number of coastal states now act as if fishery resources within their respective economic zones were national property. Conversion from property of the state to property of citizens, individual and corporate, may not be an unreasonable extension of the process.

9/ Canadian Sessional Papers, 1874

Assuming a decision were made to proceed on that understanding, it then would be expedient to institute a regime of "stinted" quantitative rights, i.e. property or quasi-property rights, for fishing enterprises and/or enterprise groups. Such rights probably would take the form of entitlements to the use of a national or state property, i.e. usufructuary rights (in contrast with rights of ownership).

The concept is simple enough. Putting it into practice, one may expect, would be an intricate and protracted process. In relatively rare instances, usufructuary rights might pertain directly to resource stocks: leaseholds for aquacultural enterprises are an obvious case in point. Conceivably, also, the right to harvest (and husband) a discrete stock of a sedentary species might be granted to an adjacent producers' organization, e.g. a co-operative or municipal corporation, provided the group were small and cohesive enough to avoid a resurgence of destructive competition internally. Territorial rights of use systems, which exist or have existed traditionally in some areas, would typify this approach and might be applicable to the management of small-scale fisheries in certain situations.

In general, however, usufructuary rights would apply to shares in a seasonal or annual harvest, i.e. in an explicit or implicit TAC. Presumably, for reasons of security for the usufructuaries, the shares would be expressed in absolute rather than proportional terms, i.e. tonnes, not percentages. A share might be defined as the minimal quantity required to ensure viability (or a break-even operation?) for the smallest-scale enterprise in a particular fishery - multiple shares being available for those of larger scale.

For the allocation of the rights under consideration, the preferred method would be a public auction. This would enable the government, on behalf of society as resource owner, to extract the rent yielded by the nation's fishery resources. The rights would be obtainable on a long-term, possibly even a perpetual, basis. To accommodate expansion of enterprises, as well as to facilitate entry and exit, these rights would be transferable. That is, subject to such rules and conditions as may be desirable, e.g. to prevent monopolization, a private market in usufructuary fishing rights would be allowed to develop.

In terms of economic efficiency, a management regime of this kind is capable (a), by inducing enterprise proprietors (with security of tenure) to produce at lowest cost, of bringing about an optimal combination of inputs of production factors in the fish-harvesting industry, and (b), consequently, of maximizing returns to those factors (including resource-rent generation). In addition, by shifting the decision-making responsibility for factor combination to private fishing enterprises, a major part of the regulatory activity of government would be eliminated.

2.2.2 The Rationalization of Mature Fisheries

What has been outlined in the preceding section is an ideal approach to fishery management, based on the "simplifying" assumption that policy makers and administrators have a free hand to direct the development of commercial fisheries under their care. In the real world, most fisheries will have matured long since and exhibit all the unfortunate features described earlier, e.g. over-capitalization, congestion, conflict among vested interests, etc. The transformation contemplated is comparable with the enclosure of common lands in Europe during the 18th century and the fencing of the open range in North America during the latter part of the last century. As an institutional innovation, it may be expected to encounter similar resistence. The conventional approach to fishery management is deeply entrenched in the administrative and research establishments of government almost everywhere. Resistence to change is likely to be encountered in industry circles also: better the devil you know than the devil you don't know! Additional barriers include:

1. Social inertia, deriving (a) from the dispersion and isolation of fishing communities (a result in some areas of moves to escape the effects of over-crowding in open access fisheries), and (b) from the associated dependence on fishing as a complementary or supplementary source of livelihood in a mixed economy.

2. Political sensitivity to the disruptive potential of interference in things as they are, the existing distribution of income in particular.

With reference to implementation, there are also practical problems to be overcome. Initially, one may assume, all enterprises already in the fisheries would have to be accommodated. Since enterprise shares in the aggregate could not exceed the relevant TAC, the suggested allocative procedure might not be admissible, i.e. assignment to the smallest-scale enterprise in a fishery of a share sufficiently large to permit at least break-even operation and multiples of that share to larger enterprises in adequate relation to their individual scale. On the other hand, to divide up a projected TAC among elegible enterprises proportionately in accordance with historic shares during a base period might deny a majority the possibility of viable operation. The preferable procedure, i.e. distribution of rights to shares on the basis of competitive bidding (open where relevant to recreational and foreign users of the resource stocks in question), while advocable for a new fishery, would not be acceptable for mature fisheries. This as well as free trading in shares, following the intial distribution, is likely to be opposed because of the advantage that would be felt to accrue to the larger and more powerful and aggressive enterprises (usually a minority).

Furthermore, until adjustment to the new regime were complete, irregularity and instability in resource availability would present formidable difficulties for allocation. These would be least significant in the case of fisheries based on stocks of sedentary and demersal species. The season-to-season variation in the catch from such stocks is relatively small overall. This does not hold for intra-regional areas, however, and only the sufficiently mobile fleet units would be assured of securing the catch to which they had obtained (by grant or purchase) a right.

The difficulties increase when stocks of pelagic species are involved: inter-seasonal variability tends to be substantially greater for these. If certain cephalopod species are included, seasonal availability with respect to locational incidence especially becomes largely unpredictable. To some extent, as in the case of demersal stocks, the problem might be resolved through mobility and the use of an effective technology. In most instances, however, it probably would be necessary to base share rights on stock availabilities averaged over some appropriate period, e.g. five years.

A similar arrangement might be workable in the case of fisheries based on stocks of certain anadromous species. The basis for allocation in this instance relates not to a total allowable catch but to a total necessary "escapement", i.e. the proportion of a run, descrete or confluent, required to perpetuate the stock(s) involved. Annual resource availability is thus an aggregate of residual quantities, subject to the effect of variation in life-cycle phases and so on. Consequently, the amplitude of year-to-year fluctuation in catches may be very great.

There are two further complications. The first arises from the intermingling and interdependence of resource stocks. As stated in an earlier section, harmony between product-market requirements and best use of resource stocks in an ecological setting would be quite exceptional. Because of this, by-catches, i.e. the incidental (and allegedly incidental) capture of certain species in directed fishing operations for other species, are often a troublesome problem for management. Its avoidance under a regime of usufructuary rights might require that temporal and spatial conditions be attached to the operations of licenced enterprises. Even this might be ineffective in the case of fisheries based on the composite stocks found in tropical regions.

A second, not entirely unassociated, complication pertains to the typical operational patterns of fishing enterprises. Many, perhaps a majority of these enterprises in some areas engage in diversified, multipurpose fishing operations. Under such circumstances, there might be a tendency to bunch landings early in a particular seasonal fishery to permit movement to a complementary fishery, with resultant diseconomies elsewhere in the system, i.e. in the processing and trading divisions. Enterprises would be especially inclined to behave in this way if only one or a few of the fisheries engaged in were under a usufructuary-rights programme, which is likely to be the usual situation in the early years of such a regime.

To counter the tendency and distribute fishing activity evenly over time, a seasonal breakdown of quota shares and/or differential pricing (equalizing expected marginal returns) might occasionally be feasible. Whether a regime of usufructuary rights, perpetual or long-term, would impel fishing enterprises toward greater specialization or toward further diversification is indeterminate at present. Evidence from fisheries under TAC control and closed entry, but without enterprise quotas or shares, is conflicting and perhaps irrelevant.

The introduction of a programme of this kind, again, would present some difficulties. In view of the preceding considerations, this would have to be by way of experiment or trial and error. To maximize the probability of success, a discrete fishery prosecuted exclusively by a homogeneous fleet of specialized fishing enterprises should be selected for this purpose - if such can be found. An additional prerequisite to the introduction of a usufructuary-rights programme, since the rights would be conferred on fishing enterprises, is that there be some formal "institutionalization" of these enterprises: either incorporation or a suitable form of registration. This might be quite impracticable for some time to come in the small-scale fisheries of developing countries.

Finally, despite the advantages of a usufructuary-rights programme for the fishing enterprises involved, problems of monitoring, surveillance and enforcement are likely to be serious - at least until the industry had adapted fully to such a regime and its advantages were clearly evident and appreciated by all participants. The inducement to cheat, i.e. to under-report catches, would be powerful. To ensure compliance with the programme, therefore, (a) accurate catch data in real time would be required by fishery-management authorities, (b) the industrial/trade structure would have to provide reliable channels of communication, and (c) the administration would have to be able, i.e. possess the capacity (an enforcement staff, a patrol fleet, a system of legal sanctions, etc.), to impose adherence to regulations. Some of these requirements, e.g. a sophisticated and comprehensive statistical service for the primary fisheries, may verge on the unimaginable for many developing countries (and not a few developed ones) in the foreseeable future.

Regretfully one must conclude that regimes of usufructuary rights in fisheries, notwithstanding their great promise, may have limited prospects of application for the present. Where examples of such a regime have or once had a traditional basis, however, these should be fostered or revived and other groups encouraged toward emulation.

We must turn, then, to alternative approaches. Among these, the second best might be a public (governmental) or private corporation vested with a monopoly of fish harvesting on a regional or national basis - the choice as between public and private monopolies depending (a) on the socio-political orientation of government, and (b) on contextual practicalities. In either case, whether harvesting operations were carried out directly, i.e. by the corporations' own fleet, or through contracting with independent vessel owners, such an entity, as in effect sole owner of the resource(s) involved, could be expected (a) to husband those resources carefully, and (b) to economize in the use of inputs to their harvest. It would be capable, that is, of optimizing the mix of benefits (employment, return on investment, service to consumers and state revenue) obtainable from fishery-resource utilization.

Where a programme of stinted usufructuary-rights for independent fishing enterprises is inapplicable or temporarily infeasible and a public or private monopoly is unacceptable (for reasons of policy or practicability), a "fallback" position might be found in a system of entry control in the primary fishing industry. 10/ Under such a system, which may be considered a prelude to or first approximation of a

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10/ An alternative approach to fishery rationalization that has been advocated by several writers, i.e. that of a levy or tax on fish landings, is rejected here as being generally impracticable. To be completely effective in blocking incentives to expansion, virtually all profits from fishing would have to be extracted. This would entail (a) varying the levy according to the stocks and areas fished, and (b) adjusting it continuously in accordance with changes in resource availability, in costs and in price. In addition to being thus extraordinarily difficult to administer, such a tax, if imposed on the marginally profitable enterprises typical of mature fisheries, also would result in widespread dislocation and hardship for fishermen.

usufructuary-rights programme, rights to fish (subject to specific restrictions) would be conveyed to a limited number of enterprises by means of a licence or permit. Besides the restrictions (on time, location and gear) conventionally applied in open-access fisheries, entry-control regulations may restrict the number, size and power of fishing craft and the number of persons engaged.

A serious flaw in this type of programme is that, in principle although it permits control of inputs and thereby of costs in fishing, it has failed to do so in practice. Since the compulsion among admitted enterprises to compete for access to resource use is not removed or even reduced, fleet capacity continues to expand and potential surpluses continue to be dissipated. This comes about because, as stated before, restrictions on one or a few dimensions of an enterprise are soon countered by increment(s) in another or others. An attempt to restrict all inputs simultaneously, while theoretically possible, would (a) give rise to horrendous problems of regulation design and enforcement, and (b) thwart technological progress in fish harvesting.

The outlook, however, may not be as unrelievedly gloomy as the foregoing review of options might suggest. An ideal may be reached by stages. Under an entry-control programme, for example, although the opportunities available to enterprise owners for sabotage are great, they are certainly not infinite. For a particular period and given applicable technology, the waste and loss of benefits caused by excessive inputs in a fish harvest may be quite tolerable. A provisional approach of this kind might be acceptable especially if entry control bought time, as it were, and provided a foundation on which to institute when opportune a programme of usufructuary-rights or comparable quasi-property rights in fishery resources for the enterprises involved.

As a step in that direction, it would be desirable that licences or entry permits be made freely transferable. Entry control implies the need for a mechanism or procedure by which entry privileges may be allocated, i.e. original entrants selected, enabled to leave when ready and replaced by new entrants. In the absence of transferability, (a) allocation is subject to more or less arbitrary bureaucratic or political decision, and (b) vessel owners, who might wish to retire from fishing, would be unable to realize any portion of the capitalized value of their licences and might incur a loss on the sale of their equipment as well. 11/ Special provisions, e.g. to avert speculation in privileged fishing rights by "absentee" investors, to prevent the concentration of rights by participants (monopolization) and to allow preference for the kin of participants in the transfer of rights, may be accommodated if necessary in the design of entry-control programmes.

To afford some security of tenure for the owners of licenced enterprises and facilitate administrative planning, entry permits or licences, instead of being granted annually, should be made available for an extended term, e.g. one related to normal periods for investment depreciation.

Where the accrual of resource rent or of capital gains for participants in an entry-controlled fishery is a matter of concern, methods for the diversion of these to the state are to be found in the form (a) of licence fees, and (b) of landings charges or royalties. Licence fees have the virtue of administrative simplicity but, because they must be levied as a flat rate for particular types and sizes of enterprise (or of fishing craft as proxy), they are unrelated to resource use and enterprise revenue and, therefore, are highly inequitable in impact. A royalty on primary production (fish caught and landed), on the other hand, besides being related directly to the quantity of fishery resources used by an enterprise, reduces the enterprise's financial ability to increase fishing power and thus contribute to the waste of other social resources. 12/

11/ A prohibition on transfers may be circumvented, incidentally, by legal strategems, clandestine deals and the like, the effect of which is to raise the cost of transactions.

12/ In theory, a royalty could be set at a rate sufficiently high to extract the resource rent in total, but rarely if ever would that be a rational (or feasible) objective of management policy.

2.3 Management Planning

2.3.1 Definition of Goals and Policy Objectives

The subject of the present discourse, apart from some account being taken of administrative expedience or feasibility, is the political economy of fisheries. Many details of policy-making are specific to individual countries, regions of countries and fisheries indigenous thereto. Those cannot be anticipated in a general treatment of this kind. It may be said, nonetheless, that fishery policy involves (a) all the laws, institutional arrangements, regulations and procedures governing the management and use of fishery resources, and (b) governmental activities that affect the fisheries indirectly, e.g. those relating to taxation, industrial and trade development and foreign affairs.

In formulating policy, the first requirement is to ensure the preservation and conservation of the natural-resource base. The additional requirements, more or less in order of priority, are: (a) economic efficiency in the utilization of fishery resources, (b) an equitable distribution of benefits from fishery development, and (c) simplicity and flexibility in fishery regulation. Protection of the resource base, the habitat and the stocks therein, obviously is a sine qua non for policy-makers: everything else is contingent on that. Efficiency in resource utilization, including the processing and marketing as well as the harvesting phases of utilization, is also an obvious desideratum in so far as it is achievable. It implies maximization of the net value, measured in monetary units, generated by the commercial fisheries, 13/ i.e. production at lowest possible cost.

Unalloyed policy formulation is seldom if ever attainable. Requirements clash and often one must be sacrificed in whole or in part for another. The pure criterion of economic efficiency, for example, sometimes must be compromised in deference to social necessity, e.g. the creation of employment opportunity or the maintenance of fishery-based communities. This is unobjectionable, provided the "sacrifice" is explicitly evaluated. In this connection, it may be mentioned that, when there is little if any alternative employment, the opportunity cost of labour is negligible. Employment in fishing, representing the utilization of an idle resource, entails no sacrifice on the part of society. Fishermen's earnings in such a situation are a social benefit, not a cost of production.

Innovation and change are ineluctable, in the fisheries as in other spheres of activity. The impact of change, e.g. shifts and alteration in the economic, institutional or regulatory environment, may be especially traumatic in fisheries, however, because of inter-group tensions stemming from the struggle for shares of a common resource. Policy initiatives add to those tensions: despite beneficial long-term results for all, there are bound to be adverse effects for some in the short term. In the formulation of policy, therefore, account must be taken of prevailing concepts of equity and fairness (a) in the granting of fishing rights and access allocation, (b) in the design of measures impinging on particular interest groups, and (c) in the distribution of the economic gains or benefits generated by the fisheries. Equity concepts tend to be difficult to reconcile both one with another and with the efficiency criterion. Between optional courses of action with a similar distributional outcome, however, the one costing least in terms of sacrificed efficiency should be chosen.

From the fact that continuous change is inevitable and that the direction of change in the future is unpredictable, it follows that policy-making and planning must be comparably adaptive and versatile. To fail in this respect is to invite the certainty of being overtaken by events. To be successful, policy also must be adaptable to effective and efficient administration. Regulatory programmes, for example, that impose the fewest and least complex requirements on the public are to be preferred. Certain forms of regulation are more critically dependent on detailed data or on close control than others. Those that prescribe behaviour that is contrary to the private economic interests of the persons and communities subject to their impact may be unenforceable. In the absence of alternative employment opportunity, the displacement of fishermen or fishing enterprises, which would have counter-equity implications, is a probable instance.

13/ This applies likewise, in countries where subsistence and/or recreational fisheries (angling) are significant, to the values generated by these forms of resource use, which are real enough although not readily measurable.

The fundamental objective of fishery-management policy has been identified as being the optimization of benefits to society from the use of fishery resources. Insight into the problem of maximizing the aggregate value yielded by fisheries may be obtained from appropriate analytical models but definitive direction for the distribution of the aggregate cannot be expected from the same source. As with externalities, issues of equity and distribution, e.g. the allocation of access among competing producers and the reduction of income disparities, originate in the mores and social standards and the political philosophy dominant in society. The form which such issues take, consequently, varies from one historical period to another. Their resolution is the responsibility of policy makers as politicians.

It is also widely recognized that resource management should apply somehow to an ecosystem, i.e. the complex of fish stocks in interaction among themselves and with their aquatic environment, in contrast with the traditional discrete-stock approach. Progress in knowledge, however, has not yet reached the point where this approach can be taken: makeshifts are still the rule. Social-benefit optimization implies ecosystem management, it has been suggested, and undoubtedly there is some interrelationship. Management of fishery-resource use in an ecological context presumably would require a properly balanced exploitation of the species stocks involved. As was pointed out earlier, however, exploitation rates normally are generated by product markets which transmit through the pricing mechanism intensive demands for some species and rejection of others. In other words, price signals do not ensure that selectivity in commercial fishing conforms with effective ecosystem management.

This variety of market failure is virtually inevitable in the short term. The longer-term outcome in a dynamic context, is uncertain: through a process of price adjustment (second-stage effects) and product substitution, an ultimate reconciliation of demand and a "rational" distribution of harvesting rates over species in an ecosystem is theoretically possible on the basis of static analysis. Meanwhile, management authority is obliged to intervene to redress the imperfections of the market. Such intervention takes various forms, e.g. a differential tax on landings and/or price subsidization, market-development programmes and the like. Adjustmental measures sometimes entail costs which have to be taken into account in evaluating the benefits to be obtained from the use of fishery resources.

Economic and social benefits and associated costs, as has been described, are realized within a complex system that embraces (a) the natural resource base, (b) the primary, secondary and tertiary components of the fishery sector, (c) product markets, i.e. those that determine the character and quantity of fishery output, and (d) factor markets, i.e. those that allocate capital and labour inputs to the fisheries. It is usually the case, unfortunately, that, for relevant policy analysis in this field, policy makers and their advisors are provided with a data base that is at best inadequate and more probably one that suffers from glaring deficiencies. Examples include measurements of price and income elasticities for specific markets, precise information on harvesting and processing costs and the multiplier effects (through linkages with other sectors of the economy) of alternative forms and directions of fishery development. In consequence, fishery managers often are forced to operate in an informational vacuum. A listing of major gaps in information, however, may serve to indicate for policy-makers the location of priorities for research.

For net social-benefit optimization, as argued above, it is necessary (among other things) that fishing enterprises be induced to minimize production costs. This is the crux of fishery management in the 1980's. The management approach advocated here, that of the institution of quasi-property or usufructuary rights for fishing enterprises, regardless of the generality or facility of its application, represents an ultimate ideal. For the present, no doubt, in most countries, second-best approaches must serve until more extensive experience has been obtained in the practical application of property-rights programmes in fisheries. Among existing approaches, that of closed entry, i.e. the licensing of a limited number of fishing enterprises (selected on an acceptable basis of eligibility) for participation in a specific fishery, offers most promise of progress in the desired direction.

Ancillary policy issues relate (a) to the initial allocation of access rights, e.g. by fiat or auction, (b) to the length and security of tenure for participants, (c) to bases or methods, e.g. transactions in an open market, for the transfer of rights between participants and from these to new entrants, and (d) to the trade-offs among employment generation, income enhancement and rent acquisition. At the heart

of these issues lies society's choice of income distribution which, in turn, depends on social/cultural value systems. With reference to the potential accrual of a resource rent, for example, the state's alternatives are:

1. To appropriate it, by tax-back or other means, on behalf of the nation (as resource owner);

2. To permit its being captured by the privileged participants in the fishery; or

3. To allow it to be dissipated by opening the fishery to the entry of additional enterprises, i.e. to create new opportunity for investment and employment in the fishery or fisheries under regulation.

To be sure, some combination of these options is possible. The state might appropriate a portion only of the actual rent available, e.g. sufficient to defray the cost of governmental programmes for fishery management and development, and permit the balance to be distributed according to one or another of the remaining alternatives. Option 2 probably would not be publicly acceptable in most societies. 14/ Adoption of Option 3 is legitimate provided that the trade-off between employment for the many and income enhancement for the relatively few is adequately evaluated and that the following conditions are met: (a) growth in employment is assigned the highest priority in policy planning, (b) the fisheries do not become an employer of last resort, which would lead to recurrence of open-access evils and thus end in futility, and (c) the resulting congestion on the fishing grounds and pressure on resource stocks is not so intense as to preclude effective management for conservation purposes.

From all this it should be clear that the scope of fishery-management policy is broad indeed. Not only is fishery regulation in itself complex and widely ramifying in effect, trends and events in other areas of national policy, e.g. those affecting industry and trade in general, the law and finance and social welfare, may have a significant impact on the commercial fisheries. Recognition of that fact is of the utmost importance in policy formulation or planning for fishery management and development. Limitation of space precludes extended treatment of policy planning in the present paper, but an outline of some of the major themes of planning may be pertinent and useful at this point.

First of all, policy making and planning are not a function of specialists or "planners" - the latter perform an analytic and advisory role (a supportive or staff function) in the planning process but the key role is that of the decision maker, i.e. the line manager or executive. The latter function extends from the minister or political head of a department or agency downward through subordinate levels of executive responsibility. Planning, as well as the execution of policy, actually is an activity of institutions rather than of individuals.

Secondly, comprehensive planning begins at the normative phase, i.e. with the setting of goals for policy makers. Goals, representing the aspirations or aims of a whole society, may be articulated only by legitimate political leadership. They differ, therefore, from country to country and through time. Societal goals as understood here usually manifest the existence of a "grand design" and tend to be given vague or broadly inclusive expression. Consequently, for the use of policy makers in a specific field such as fisheries, they must be interpreted in operational terms. Even in these terms, no necessary ordering of priorities is disclosed. Goals frequently are in conflict one with another and some may be mutually exclusive. The pursuit of a particular goal thus imposes a constraint on the achievement of other goals and trade-offs are inescapable.

14/ Nevertheless, this is what tends to occur in the case of closed-entry programmes. Such programmes usually are introduced in conditions, i.e. over-capitalization and general privation, that do not permit recovery of a (non-existent) surplus by state authorities. Under entry control, however, surpluses quickly emerge and, in the interest of equitable income distribution, should be extracted in large part for the public, e.g. by means of a royalty on primary production. Otherwise the (capitalized) value of resource rent tends to be realized in total by the first generation of entrants.

The next step in the planning process, therefore, is the identification of goal priorities or preferred policy objectives. At this point, coordination of planning with policy makers in the several relevant fields enumerated above, for the purpose of integrating plans over a sufficiently wide front, becomes of the greatest importance and urgency. In this way the activities of a number of diverse agencies are made reciprocally reinforcive, the public is spared the spectacle of government departments working at cross purposes and idiotic mistakes, like the introduction of programmes that destroy the effect of other programmes, e.g. financial incentives for industrial expansion that nullify measures to protect endangered fish stocks, are avoided.

2.3.2 Strategies, Tactics and Adaptation to Change

Various policy objectives, relating to resource use and allocation, industrial and trade development and the creation of social/cultural benefits, may be formulated for fishery management. To a greater extent even than societal goals, however, such objectives are bound to differ among countries. In occasional instances, objectives of more or less universal validity may be identified, e.g. "Security of the base for productive fisheries within the complex of demands on the aquatic environment", "Elimination of wastage at all stages of production", and "Minimization of the socially and culturally disruptive impact of industrial change". In other instances, specific objectives of relevance elsewhere may not be pertinent to a particular nation's needs or to the stage of development of its fisheries.

A point that should be made is that there may be important cases of trade-off between short-term and long-term objectives. In the immediate future, for example, the creation of additional employment opportunity may be of primary concern, although trade expansion is the more distant target. Measures directed toward realization of the former objective, by building into the system certain types of high-cost production, could forestall achievement of the latter. It is incumbent on policy makers, through sound policy analysis and integration of fishery plans with those for other sectors, to prevent the occurrence of such an eventuality. To the utmost extent possible, pre-emption of options for the future should not be permitted.

Policy objectives having been chosen and priorities identified, strategies must be devised to ensure - or, rather, to maximize the probability of - the objectives being reached within the selected time frame. This is the strategic phase of the planning process. Strategies provide the rules, directions or guidelines required for competent tactical planning, i.e. the design of programmes, which, of course, are the end-products of the process. Neglect of strategic planning is a common fault of bureaucracies. There is an almost invincible tendency on the part of administrators to do more of what has been done before. The effect is (a) to maintain or repeat programmes that are no longer pertinent, and may in fact be prejudicial, to the needs of the real world, and (b) to divert scarce talent and funding from the design and delivery of programmes that are really needed. Scrupulous adherence to strategic directives is recommended for the cure of this bureaucratic malady.

Since strategies follow from policy objectives, each fishery-management authority must devise their own. Guidelines are required for programming over the whole range of fishery-management issues, including (a) research, i.e. the establishment and maintenance of an adequate knowledge base, (b) resource-use regulation, (c) industrial and trade development, and (d) advancement of social and cultural ends. Guidelines relevant to research programming, for example, might include those specifying the nature of the regulatory regime projected, intensions respecting product development and so on. The nature of knowledge requirements would flow from those specifications.

Although programmes must be specific as to place and time, as well as purpose, certain general criteria for programme design may be prescribed. Regulations to control the operation of the primary fishing industry (fishing enterprises collectively), for example, should (a) induce the industry to operate at minimal average cost of production, (b) encourage progress in efficiency, e.g. through technological innovation, (c) command the support of a concensus among those affected, and (d) be adaptable to changing conditions 15/ and, if necessary, to gradual implementation. Further, in designing the regulations, the distributional effects, associated costs and other political constraints must be taken into account.

15/ Because of deficient knowledge of species interactions and the like, this is said to be a particularly important consideration in the case of fisheries based on the multi-species stocks typical of the tropics.

Criteria of similar generality may be prescribed for the design of developmental programmes. As a rule, these programmes should be directed toward the creation of an economic and institutional environment conducive to the growth and efficient performance of the fishing industry (primary and secondary) and of the fish trade. Appropriate examples are programmes (a) to correct imperfections in factor markets, (b) to provide needed infrastructure, (c) to assist in the establishment of an effective marketing organization, and (d) to supply research and extension services. Programme design should also aim at maximal cost-effectiveness, i.e. of available alternatives, that which achieves the object at lowest cost should be chosen. Finally, in view of the insidious tendency of subsidization (a) to pervert private investment decisions, and (b) to prolong dependence on public funding, a subsidy to promote fishery development should be granted only when there is reasonable assurance that the assistance will become unnecessary and can be phased out.

In devising strategies and designing programmes in accordance with strategic directives, heed should be taken of the fact that (in market economies) policy making and planning is a dual process. That is to say, decisions as to investment and employment in the fisheries are also being made by private individuals, cooperatives, firms and corporations. It is of the greatest importance to these entities that the policy environment in which they operate, i.e. the framework of regulations, taxation rules and other relevant programmes, be reasonably stable and predictable. At the same time, as indicated earlier, operational efficiency may require that rules and regulations be applied with some flexibility. Rigid application that failed to allow (a) for the values, motivations and attitudes of those affected, and/or (b) for the distributional implications of fishery management and development programmes, could be disastrous. It has been pointed out, for example, that the introduction of an advanced technology is likely to come to nothing if, for cultural reasons or out of necessity, boat owners are averse to risk-taking.

It is very important too that governmental decision-making be seen to be responsive to reality. Policy formulation and planning properly is an iterative process in which planners and decision-makers interact with client groups, i.e. in the present context, fishery-oriented industry and trade organizations or their representatives and other interested circles. The mechanisms and instrumentalities by means of which this takes place vary with the historical experience, the political philosophy and the conventional practice of different countries. In parliamentary democracies, the national legislature is the principal channel of client input, with special-interest organizations ("pressure groups" and "lobbies"), playing a subsidiary role. The last-mentioned sources of input may be augmented by the establishment of formal and ad hoc cosultative or advisory bodies (councils, committees, etc.).

Of equal importance is incorporation in the policy-making process of effective "feedback" from recipients of fishery-management and development programmes and assurance of prompt and expeditious adaptation of planning to change in the internal and external conditions of the fisheries. Besides sensitivity and responsiveness on the part of decision makers, this requires (a) that administrators and officials be held strictly accountable to the political leadership for programme results, and (b) that a comparatively elaborate quantitative (statistical) and qualitative intelligence service, for programme-impact evaluation and policy analysis, be put in place - a requirement that developing countries may find difficult to meet.

APPENDIX A

Selected Items of Equipment and Supply for Fish Harvesting and Processing *

Propulsion Units (Marine Engines) :

Inboard)
Outboard) Diesel and Gasoline

Navigation Equipment and Instruments :

Loran & Radar
Autopilot

Communication Equipment :

Transmitters/Receivers
Radio-Telephone

Fish-Harvesting Gear and Equipment :

Sonor & Echo-Sounding Devices (Fish Finders)
Winches & Gurdies (Hydraulic, Electrical and Mechanical)
Traps & Drags
Nets (Set, Drift, Seine, Trawl, etc.)
Lines & Cordage (Twine, Rope)

Fish Handling and Processing Equipment :

Generators
Blowers, Fans & Pumps
Cranes & Hoists
Lift-Trucks
Conveyers & Conveyer Systems
Cutting, Splitting, Skinning & Peeling Machinery
Smokers
Mechanical Dryers
Retorts
Shredders
Grinders
Continuous Cookers
Freezers
Containers & Packaging Materials

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* Other than fishing craft, wharves and buildings

APPENDIX B

Fishery-Type Regulations as Applied to the Primary Forest Industry (A Parody) *

1. Logging will begin at 6.00 a.m., 15 June, and close at 6.00 p.m., 1 October, in even numbered townships and sections.

2. Logging will be permitted on Tuesdays and Fridays, subject to extension or restriction by field announcements.

3. A logging licence, to cost $25.00, must be purchased prior to 1 April.

4. It shall be unlawful for any person, firm or corporation to use, employ or operate a power-driven saw for the purpose of removing timber.

5. Hand axes must have a blade of less than four inches but more than three inches, with a handle to exceed 18 inches.

6. No logger shall have in his possession more than one axe.

7. Each axe shall be legibly marked with the registration number and initials of the operator.

8. No axe shall be placed or operated less than 600 feet from any other axe.

9. No logging truck shall be longer than 30 feet overall, except trucks that logged prior to 1 January, 1960.

10. Trees with cones can be harvested only prior to 31 July.

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APPENDIX C

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